INTEL PATENT
81674-249983

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

CAPEWELL, D., et al.

Serial No: 10/003,075

Filed: October 31, 2001

For: SYSTEM AND METHOD FOR COLLIMATING AND REDIRECTING BEAMS IN A FIBER OPTIC SYSTEM

Examiner: Wood, K. S.
Art Unit: 2874

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Hon. Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450, on

September 10, 2003.
Date of Deposit

Roger R. Wise
Name

Roger R. Wise 09/10/2003
Signature Date

Amendment

Mail Stop Non-Fee Amendment
Hon. Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Office Action dated June 13, 2003 in connection with the above-identified application, please enter and consider the following amendment and remarks.

IN THE CLAIMS:

Please cancel claims 23-38, amend claim 1, and rewrite in independent form claims 2, 3, 21, and 22 as follows:

1. (Currently Amended) A connector to an optical fiber, comprising: a prism that includes a triangular wedge element having a first surface, a second surface and a base;

a ferrule to guide the optical fiber so as to contact the optical fiber with the first surface of the prism, the first surface being substantially perpendicular to the optical fiber; and

an aspheric lens integrated on the second surface, the integrated aspheric lens being positioned so that the prism serves to redirect a light beam at an angle relative to an axis of ~~the~~ an optical source input through total internal reflection by utilizing the base of the triangle wedge element, the aspheric lens serving to at least one of collimate the redirected light beam and focus the light beam before being redirected.

2. (Rewritten in independent form) ~~The connector of claim 1,~~ A connector to an optical fiber, comprising:

a prism that includes a triangular wedge element having a first surface, a second surface and a base;

a ferrule to guide the optical fiber so as to contact the optical fiber with the first surface of the prism, the first surface being substantially perpendicular to the optical fiber; and

an aspheric lens integrated on the second surface, the integrated aspheric lens being positioned so that the prism serves to redirect a light beam at an angle relative to an axis of an optical source input through total internal reflection by utilizing the base of the triangle wedge element, the aspheric lens serving to at least one of collimate the redirected light beam and focus the light beam before being redirected, wherein the connector is a fiber collimator.

3. (Rewritten in independent form) ~~The connector of claim 1,~~ A connector to an optical fiber, comprising:

a prism that includes a triangular wedge element having a first surface, a second surface

surface and a base;

a ferrule to guide the optical fiber so as to contact the optical fiber with the first surface of the prism, the first surface being substantially perpendicular to the optical fiber; and

an aspheric lens integrated on the second surface, the integrated aspheric lens being positioned so that the prism serves to redirect a light beam at an angle relative to an axis of an optical source input through total internal reflection by utilizing the base of the triangle wedge element, the aspheric lens serving to at least one of collimate the redirected light beam and focus the light beam before being redirected, wherein the connector is a fiber coupler.

4. (Original) A fiber collimator, comprising:

a prism that includes a triangular wedge element having a first surface, a second surface and a base;

a ferrule to guide an optical source input to the fiber collimator so as to contact the optical source input with the first surface of the prism, the first surface being substantially perpendicular to the optical source input; and

an aspheric lens integrated on the second surface, the integrated aspheric lens being positioned so that the prism serves to redirect a light beam at an angle relative to an axis of the optical source input, and the aspheric lens serves to collimate the redirected light beam, the base of the triangle wedge element redirecting the light beam by total internal reflection (TIR).

5. (Original) The fiber collimator of claim 4, wherein the triangular wedge element is an isosceles triangle wedge, the length of the first surface being equal to the length of the second surface.

6. (Original) The fiber collimator of claim 4, wherein the prism further comprises a spacer element, the spacer element providing a mechanism to adjust an optical path length from the aspheric lens to the optical source input, allowing the focal length of the aspheric lens, and thereby the radius of the collimated light beam, to be adjusted while keeping the dimensions of the triangle wedge element constant.

7. (Original) The fiber collimator of claim 4, wherein diamond-turned inserts are utilized to define optical quality surfaces, including those for at least one of the prism, the aspheric lens and the TIR surface.

8. (Original) A fiber coupler, comprising:

a prism that includes a triangular wedge element having a first surface, a second surface and a base;

an aspheric lens integrated on the second surface, the integrated aspheric lens receiving a light beam, the aspheric lens being positioned so that the light beam is focused after passing through the aspheric lens, creating a focal spot image; and

a ferrule to guide an optical fiber of the fiber coupler so as to contact an optical fiber core of the optical fiber with the first surface of the prism at or near the location of the focal spot image, wherein the base of the triangle wedge element serves to redirect the focused light beam by total internal reflection (TIR) at an angle relative to an axis of the optical fiber, the focused light beam being directed into the optical fiber core.

9. (Original) The fiber coupler of claim 8, wherein the triangular wedge element is an isosceles triangle wedge, the length of the first surface being equal to the length of the second surface.

10. (Original) The fiber coupler of claim 8, wherein the prism further

comprises a spacer element, the spacer element providing a mechanism to adjust an optical path length from the aspheric lens to the optical fiber, allowing the focal length of the aspheric lens, and thereby the numerical aperture of the light delivered to the optical fiber, to be adjusted while keeping the dimensions of the triangle wedge element constant.

11. (Original) The fiber coupler of claim 8, wherein the light beam received by the aspheric lens is an elliptically shaped, collimated light beam and the focal spot imaged onto the fiber core is circular or substantially circular, the base of the triangle wedge element having curvature to enable this TIR surface to act as a cylindrical mirror, the aspheric lens being toric with its principle axes aligned with those of the cylindrically curved TIR surface, the combination of the cylindrically curved TIR surface and the toric aspheric lens serving to collimate and correct for spherical aberrations and rendering the focal spot imaged onto the fiber core circular or substantially circular.

12 (Original) The fiber coupler of claim 8 wherein the lens parameters for the aspheric lens is optimized by utilizing a source with a numerical aperture that completely fills the full aperture of the lens.

13 (Original) A collimating element, comprising:

a prism that includes a triangular wedge element having a first surface, a second surface and a base, the base of the triangle wedge element having curvature to enable it to act as a cylindrical mirror to redirect the light beam by total internal reflection; and an aspheric lens integrated on the second surface, the aspheric lens being toric with principle axes aligned with those of the cylindrically curved base of the triangle wedge element, the integrated aspheric lens being positioned so that a chief ray of the light

beam passes directly through the axis of the aspheric lens, wherein the light beam from an optical source input is an elliptically shaped beam, the elliptically shaped beam being redirected at an angle relative to an axis of the optical source input by the cylindrically curved base, the redirected light beam being collimated by the aspheric lens, the collimated light beam being a circularly or substantially circularly shaped beam, wherein the aspheric lens serves to collimate the redirected light beam, the base of the triangle wedge element redirecting the light beam by total internal reflection.

14. (Original) The collimating element of claim 13, wherein the optical source input is an edge-emitting laser.

15. (Original) A collimating optical subassembly for collimating and redirecting a divergent light beam from a point source, comprising:

an aspheric lens that receives and collimates the divergent light beam, creating a collimated light beam;

a spacer element above the aspheric lens; and

a wedge element that refracts the collimated light beam into air at an angle relative to the axis of the aspheric lens consistent with Snell's law, the wedge element being positioned above the spacer element, wherein the collimating optical subassembly is fabricated of optically transparent material and integrated as a single part using injection-molding techniques.

16. (Original) The collimating optical subassembly of claim 15, wherein the point source is a vertical cavity surface emitting laserdiode.

17. (Original) The collimating optical subassembly of claim 15, wherein the spacer element is inserted to allow molten optically transparent material to more easily

flow through a mold for fabricating the collimating optical subassembly using standard injection molding techniques.

18. (Original) The collimating optical subassembly of claim 15, wherein the prism is made of an optically transparent material, the optically transparent material including any one of polycarbonate, polyolefin and polyethylimide.

19. (Original) The collimating optical subassembly of claim 15, wherein the aperture of the aspheric lens is made larger than the waist of collimated light beam outputted from the wedge element.

20. (Original) A focusing optical subassembly for redirecting and focusing a collimated light beam, comprising:

a wedge element that receives the collimated light beam traveling in air;

a spacer element below the wedge element; and

an aspheric lens below the spacer element, wherein the focusing optical subassembly is fabricated of optically transparent material and integrated as a single part using injection-molding techniques, and wherein the collimated light beam received by the wedge element travels in air at an angle relative to an axis of the aspheric lens, the wedge element redirecting a chief ray of the collimated beam through the spacer element along the axis of the aspheric lens, the aspheric lens focusing the collimated light beam to a point along its axis.

21. (Rewritten in independent form) ~~The focusing optical subassembly of claim 20,~~ <u>A focusing optical subassembly for redirecting and focusing a collimated light beam, comprising:</u>

<u>a wedge element that receives the collimated light beam traveling in air;</u>

a spacer element below the wedge element; and

an aspheric lens below the spacer element, wherein the focusing optical subassembly is fabricated of optically transparent material and integrated as a single part using injection-molding techniques, wherein the collimated light beam received by the wedge element travels in air at an angle relative to an axis of the aspheric lens, the wedge element redirecting a chief ray of the collimated beam through the spacer element along the axis of the aspheric lens, the aspheric lens focusing the collimated light beam to a point along its axis, and wherein a photodetector resides at the point to which the collimated light beam is focused by the aspheric lens.

22. (Rewritten in independent form) ~~The focusing optical subassembly of claim 20,~~ A focusing optical subassembly for redirecting and focusing a collimated light beam, comprising:

a wedge element that receives the collimated light beam traveling in air;

a spacer element below the wedge element; and

an aspheric lens below the spacer element, wherein the focusing optical subassembly is fabricated of optically transparent material and integrated as a single part using injection-molding techniques, and wherein the collimated light beam received by the wedge element travels in air at an angle relative to an axis of the aspheric lens, the wedge element redirecting a chief ray of the collimated beam through the spacer element along the axis of the aspheric lens, the aspheric lens focusing the collimated light beam to a point along its axis, and wherein the spacer element is inserted to allow molten optically transparent material to more easily flow through a mold for fabricating the focusing optical subassembly using standard injection molding techniques.

REMARKS

Claims 1-22 are pending. Claims 23-38 have been cancelled. Claim 1 has been amended. Claims 2, 3, 21, and 22 have been rewritten in independent form. No new matter has been introduced. Reexamination and reconsideration of the application are respectfully requested.

In the June 13, 2003 Office Action, the Examiner allowed claims 4-19. The Examiner objected to the drawings as failing to comply with 37 CFR 1.84(p)(5). The Examiner stated that reference signs 1, 2, 3, 5, and 6 are not mentioned in the description. The Applicants respectfully point out that the reference signs 1, 2, 3, 5, and 6 are described on page 1 of the specification.

The Examiner rejected claim 1 under 35 U.S.C. §112, second paragraph, for insufficient antecedent basis for a limitation in the claim. The Examiner indicated that claim 1 would be allowable if rewritten or amended to overcome this rejection. Claim 1 has been amended to overcome this rejection. The Applicants believe amended independent claim 1 is in condition for allowance.

The Examiner objected to claims 2, 3, 21 and 22 as being dependent upon a rejected base claim, but indicated that such claims would be allowable if rewritten in independent form including all of the limitations of the base claims and any intervening claims. By this amendment, the Applicants have rewritten in independent form claims 2, 3, 21 and 22 in accordance with the Examiner's remarks.

The Applicants believe rewritten independent claims 2, 3, 21 and 22 are in condition for allowance.

The Examiner rejected claim 20 under 35 U.S.C. §103 as being obvious over Davies et al., U.S. Patent No. 6,269,203 (hereinafter the Davies reference). This rejection is respectfully traversed.

Independent claim 20 recites:

A focusing optical subassembly for redirecting and focusing a collimated light beam, comprising:

a wedge element that receives the collimated light beam traveling in air;

a spacer element below the wedge element; and

an aspheric lens below the spacer element, wherein the focusing optical subassembly is fabricated of optically transparent material and integrated as a single part using injection-molding techniques, wherein **the collimated light beam** received by the wedge element **travels in air at an angle relative to an axis of the aspheric lens**, the wedge element redirecting a chief ray of the collimated beam through the spacer element along the axis of the aspheric lens, the aspheric lens focusing the collimated light beam to a point along its axis.

The Examiner rejected claim 20 under 35 U.S.C. §103 as being obvious over the Davies reference. In so doing the Examiner stated "Davies et al. discloses a focusing optical device including: a wedge element (62) that receives the collimated beam, a spacer element, and an aspheric lens (74), where the assembly is fabricated of optically transparent material and integrated as a single part."

The Davies reference does not disclose, teach, or suggest the focusing optical subassembly as specified in independent claim 20. Unlike the focusing optical subassembly specified in independent claim 20, the Davies reference does not show a

focusing optical subassembly comprising "**a spacer element** below the wedge element; and **an aspheric lens** below the spacer element, wherein the focusing optical subassembly is fabricated of optically transparent material and integrated as a single part using injection-molding techniques, wherein **the collimated light beam** received by the wedge element **travels in air at an angle relative to an axis of the aspheric lens**".

The Applicants respectfully submit that the Davies reference does not teach the invention as specified in independent claim 20. The Davies reference states "FIGS. 1 through 7 illustrate that the present invention utilizes **surface-normal geometry for entry** and exit of light beams into and out of the WD(D)M device." (Col. 7, lines 44-46.) Whereas, independent claim 20 recites that "**the collimated light beam** received by the wedge element **travels in air at an angle relative to an axis of the aspheric lens**". Therefore, the collimated light beam, as specified in independent claim 1, does not enter the wedge element surface-normal but is received by the wedge element at an angle relative to an axis of the aspheric lens.

The Davies reference further states "FIG. 4 illustrates an embodiment of the present invention wherein the refracting element is **a cylindrical lens 68** that is directly mounted to the stack of transmission gratings 70, 71. The cylindrical lens 68 **collimates the input light beam from the source 66**, which is input at the surface normal angle." (Col. 7, lines 55-61.) However, referring to FIG. 4, there appears to be no cylindrical lens 68 only an element 50. There also is no source 66, however, there is a fiber 6 including a core 8. Assuming that the element 50 is a cylindrical lens and the source is the fiber 6, a cylindrical lens cannot collimate a divergent light beam from source 6

which is a fiber. This is physically impossible because a single cylindrical lens has power, i.e. curvature in only one direction. Even assuming that the element 50 were not a cylindrical lens and that it could collimate the input light beam, the collimated input beam never "**travels in air at an angle relative to an axis of the aspheric lens**" as recited in independent claim 20. The Davies reference states that a cylindrical lens 68 is directly mounted to the stack of transmission gratings 70, 71. The cylindrical lens 68 collimates the input light beam from the source 66, which is input at the surface normal angle.

The Davies reference also states "this embodiment also illustrates the use of a curved surface 74 which is molded onto the surface of the substrate 62, for the purpose of providing focusing of the output light beams into the focal plane 76." (Col. 9, lines 30-34.) The Davies reference describes a curved surface 74 but makes no mention whatsoever of "**a spacer element** below the wedge element; and **an aspheric lens** below the spacer element". The Davies reference makes no mention whatsoever of a spacer element or an aspheric lens.

Finally, the Davies reference clearly teaches a folded geometry by stating "FIGS. 1, 3, and 4 illustrate that a novel feature of the transparent substrate 2, 42, 62 of some embodiments of the present invention is the use of folded geometry." (Col. 7, lines 16-18.) Independent claim 20 recites an in-line geometry, i.e., a wedge, a spacer element below the wedge, and an aspheric lens below the spacer element.

Accordingly, the applicants respectfully submit that independent claim 20 distinguishes over the above-cited reference.

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Applicants believe that the foregoing amendment and remarks place the application in condition for allowance, and a favorable action is respectfully requested.

If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Los Angeles telephone number (213) 488-7100 to discuss the steps necessary for placing the application in condition for allowance should the examiner believe that such a telephone conference would advance prosecution of the application.

Respectfully submitted,

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Date: September 10, 2003

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